

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Wagner, M., et al.
SERIAL NO.: 10/804,640 GROUP NO.: 2883
FILING DATE: March 19, 2004 EXAMINER: James P. Hughes
TITLE: TUNABLE AND SWITCHABLE MULTIPLE-CAVITY THIN
FILM OPTICAL FILTERS

Commissioner for Patents
Alexandria, Virginia 22313-1450

AMENDMENT AND RESPONSE

Sir:

The following amendments and remarks are responsive to the Office Action mailed on April 5, 2006. Entry and consideration of the following amendments and remarks, and allowance of the claims, as presented, are respectfully requested. A Petition for a three-month extension of time, up to and including October 7, 2006 is submitted herewith. Authorization to charge Attorney's charge card for the extension fee and any other proper fees is given in the EFS-Web filing submission papers

Amendments to the claims begin on page 2 of this paper.

Remarks begin on page 10 of this paper.

Amendments to the Claims:

Please cancel claim 25, add claims 31-40, and amend claims 23 and 26 as follows:

- 1 1. (Withdrawn): A switchable optical filter comprising:
 - 2 a first thin-film optical bandpass filter portion; and
 - 3 a second thin-film optical bandpass filter portion, wherein both the first and second
 - 4 thin-film optical bandpass filter portions are adjacent to each other and are parts of a single
 - 5 integral structure, and wherein the first thin-film optical bandpass filter portion is thermally
 - 6 tunable and is characterized by a passband that shifts as a function of temperature and
 - 7 wherein the second thin-film optical bandpass filter portion is thermally non-tunable.
- 1 2. (Withdrawn): The switchable optical filter of claim 1, wherein the first and second thin-
- 2 film optical bandpass filter portions are integrally formed one on top of the other.
- 1 3. (Withdrawn): The switchable optical filter of claim 1, wherein the second thin-film
- 2 optical bandpass filter portion comprises a Fabry-Perot cavity.
- 1 4. (Withdrawn): The switchable optical filter of claim 1, wherein the second thin-film
- 2 optical bandpass filter portion comprises a plurality of cavities fabricated one on top of the
- 3 other.
- 1 5. (Withdrawn): The switchable optical filter of claim 1, wherein the second thin-film
- 2 optical bandpass filter portion comprises an etalon that is characterized by multiple
- 3 passbands spaced from each other and wherein the passband of first thin-film optical
- 4 bandpass filter portion is thermally tunable over the multiple passbands of the etalon.

- 1 6. (Withdrawn): The switchable optical filter of claim 1, wherein the first thin-film optical
- 2 bandpass filter portion comprises a Fabry-Perot cavity.

- 1 7. (Withdrawn): The switchable optical filter of claim 1, wherein the first thin-film optical
- 2 filter portion comprises a plurality of cavities fabricated one on top of the other.

- 1 8. (Withdrawn): The switchable optical filter of claim 1 wherein the first thin-film optical
- 2 bandpass filter portion includes a heating element for controlling a temperature of the first
- 3 thin-film optical bandpass filter.

- 1 9. (Withdrawn): The switchable optical filter of claim 1 wherein the first thin-film optical
- 2 bandpass filter portion comprises a layer of amorphous silicon.

- 1 10. (Withdrawn): The switchable optical filter of claim 1 wherein the first thin-film optical
- 2 bandpass filter portion comprises multiple layers of amorphous silicon.

- 1 11. (Withdrawn): A switchable optical filter comprising:
 - 2 a first thermally tunable thin-film optical bandpass filter portion;
 - 3 a second thermally tunable thin-film optical bandpass filter portion, wherein both the
 - 4 first and second tunable thin-film optical bandpass filters are arranged next to each other on
 - 5 an optical path; and
 - 6 a spacer separating and thermally isolating the first and second tunable thin-film
 - 7 optical bandpass filter portions from each other so that either one of said first and second
 - 8 optical bandpass filter portions can be thermally tuned independently of the other one of
 - 9 them.

- 1 12. (Withdrawn): The switchable optical filter of claim 11 wherein the spacer is an air gap.

- 1 13. (Withdrawn): The switchable optical filter of claim 11 wherein the spacer is a solid
- 2 dielectric material.

- 1 14. (Withdrawn): The switchable optical filter of claim 13 wherein the spacer is made of
- 2 silica.

- 1 15. (Withdrawn): The switchable optical filter of claim 11 wherein the first thermally
- 2 tunable thin-film optical bandpass filter portion is characterized by a first passband that shifts
- 3 as a function of temperature, said first thermally tunable thin-film optical filter portion
- 4 including a first heater element for controlling a temperature of the first thermally tunable
- 5 thin-film bandpass filter portion so as to control a location of the first passband.

- 1 16. (Withdrawn): The switchable optical filter of claim 15 wherein the second thermally
- 2 tunable thin-film optical bandpass filter portion is characterized by a second passband that
- 3 shifts as a function of temperature, said second thermally tunable thin-film optical filter
- 4 portion including a second heater element for controlling a temperature of the second
- 5 thermally tunable thin-film bandpass filter portion so as to control a location of the second
- 6 passband.

- 1 17. (Withdrawn): The switchable optical filter of claim 15, wherein the first thermally
- 2 tunable thin-film optical bandpass filter portion comprises a Fabry-Perot cavity.

- 1 18. (Withdrawn): The switchable optical filter of claim 15, wherein the first thermally
- 2 tunable thin-film optical bandpass filter portion comprises a plurality of cavities fabricated
- 3 one on top of the other.

- 1 19. (Withdrawn): The switchable optical filter of claim 16, wherein the second thermally
- 2 tunable thin-film optical bandpass filter portion comprises a Fabry-Perot cavity.

1 20. (Withdrawn): The switchable optical filter of claim 16, wherein the second thermally
2 tunable thin-film optical bandpass filter portion comprises a plurality of cavities fabricated
3 one on top of the other.

1 21. (Withdrawn): A switchable optical filter comprising:
2 a first optical bandpass filter portion; and
3 a second optical bandpass filter portion, wherein both the first and second optical
4 bandpass filter portions are arranged adjacent to each other to form a single
5 interferometrically-coupled optical filter structure, and wherein the first optical bandpass
6 filter portion is tunable and is characterized by a passband that shifts as a function of a
7 control parameter and wherein the second optical bandpass filter portion is non-tunable.

1 22. (Withdrawn): The switchable optical filter of claim 21, wherein the control parameter is
2 temperature.

1 23. (Amended): A switchable optical filter comprising:
2 a first tunable optical bandpass filter portion characterized by a first passband that
3 shifts as a function of a first control parameter; and
4 a second tunable optical bandpass filter portion characterized by a second passband
5 that shifts as a function of a second control parameter, wherein both the first and second
6 optical bandpass filter portions form a single integral interferometrically optically-coupled
7 structure; and
8 a spacer separating and isolating the first and second tunable optical bandpass filter
9 portions from each other so that either one of said first and second optical bandpass filter
10 portions can be tuned independently of the other one of them.

1 24. (Original): The switchable optical filter of claim 23, wherein the first control parameter is a
2 temperature of the first tunable optical bandpass filter portion and the second control parameter
3 is a temperature of the second tunable optical bandpass filter portion.

1 25. Cancelled

1 26. (Amended): The switchable optical filter of claim ~~24~~ 25 wherein the first tunable optical
2 bandpass filter portion includes a heater element for controlling the temperature of the first
3 tunable optical bandpass filter.

1 27. (Original): The switchable optical filter of claim 26 wherein the second tunable optical
2 bandpass filter portion includes a heater element for controlling the temperature of the second
3 tunable optical bandpass filter.

1 28. (Withdrawn): An add/drop optical circuit comprising a plurality of switchable thin-film
2 optical filters each of which has a first optical terminal for receiving an optical signal, a second
3 optical terminal for outputting an optical signal that is reflected by that switchable thin-film
4 optical filter and a third optical terminal for carrying an optical add/drop signal, wherein the
5 switchable thin-film optical filters of the plurality of switchable thin-film optical filters are
6 connected in series via the first and second optical terminals of the plurality of switchable thin-
7 film optical filters and wherein each of the switchable thin-film optical filters of the plurality of
8 switchable thin-film optical filters comprises a thermally tunable thin-film optical bandpass filter
9 portion having a passband that shifts as a function of temperature.

1 29. (Withdrawn): The add/drop optical circuit of claim 28 wherein each switchable thin-film
2 optical filter of said plurality of switchable thin-film optical filters further comprises a second

3 thin-film optical bandpass filter portion, wherein both the first and second thin-film optical
4 bandpass filters form a single integral filter structure, and wherein the second thin-film optical
5 bandpass filter portion is thermally non-tunable.

1 30. (Withdrawn): The add/drop optical circuit of claim 28 wherein each switchable thin-film
2 optical filter of said plurality of switchable thin-film optical filters further comprises:
3 a second thermally tunable thin-film optical bandpass filter portion; and
4 a spacer separating and thermally isolating the first-mentioned and second tunable thin-
5 film optical bandpass filter portions from each other so that either one of said first and second
6 optical bandpass filter portions can be thermally tuned independently of the other one of them,
7 wherein the first-mentioned and second tunable thin-film optical bandpass filter portions and the
8 spacer form a single integral filter structure.

1 31. (New): The switchable optical filter of claim 23 wherein the switchable optical filter
2 switches between one of a transmissive state and a reflective state.

1 32. (New): The switchable optical filter of claim 23, wherein one of the first control parameter
2 and second control parameter comprises a temperature of a respective one of the first tunable
3 optical bandpass filter portion and the second tunable optical bandpass filter portion.

1 33. (New): The switchable optical filter of claim 23, wherein the spacer comprises an air gap.

1 34. (New): The switchable optical filter of claim 23, wherein the spacer comprises a solid
2 dielectric material.

1 35. (New): The switchable optical filter of claim 23, wherein the first and the second passbands
2 have the same transmission characteristics.

- 1 36. (New): A method of optical switching, the method comprising:
 - 2 selecting a first temperature of a first thermally tunable optical bandpass filter;
 - 3 filtering an optical signal with the first thermally tunable optical bandpass filter operating
 - 4 at the first temperature;
 - 5 propagating the filtered optical signal through a spacer layer;
 - 6 selecting a second temperature of a second thermally tunable optical bandpass filter; and
 - 7 filtering the filtered optical signal propagated through the spacer layer with the second
 - 8 thermally tunable optical bandpass filter operating at the second temperature.
- 1 37. (New): The method of claim 36 wherein the selecting the first and the second temperatures
- 2 comprises a two-step sequence.
- 1 38. (New): The method of claim 36 wherein the first and second tunable optical bandpass filter
- 2 have the same transmission characteristics.
- 1 39. (New): The method of claim 36 wherein the first temperature is independent of the second
- 2 temperature.
- 1 40. (New): The method of claim 36 further comprising choosing a thickness of the spacer layer
- 2 so that the first and the second thermally tunable optical bandpass filters form a single multi-
- 3 cavity structure.

REMARKS

Pending Claims

Claims 23-24, 26-27 and 31-40 are pending in the present application. Claims 23 and 26 have been amended. Claims 1-22 and 28-30 have been withdrawn from consideration pursuant to 37 CFR §1.142(b) as being drawn to non-elected groups. Claims 23 and 26 have been amended. New claims 31-40 have been added. The Applicant respectfully requests reconsideration of the pending claims in light of the amendments and remarks presented in this Amendment and Response.

Objections to the Claims

Independent claim 23 is objected to because the Examiner believes that it fails to clearly identify what the Applicants regard as the invention. In particular, the Examiner believes that the term “integral interferometrically-coupled structure” is not clear. In addition claims 24-27 are objected to because the Examiner believes that these claims inherit the deficiencies of claim 23. Independent claim 23 has been amended to replace the term “integral interferometrically-coupled structure” with the term “optically-coupled structure”. The Applicants submit that the amendment to independent claim 23 overcomes the objections to claims 23-27 and respectfully requests that the objection to the claims be withdrawn.

Rejections under 35 U.S.C. §103(a) As Being Obvious

Claims 23-27 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Publication Number 2002/0191268 to Seeser et al. The Office Action dated April 7, 2006 states on page 3 that the Seeser teaches a switchable optical filter comprising a plurality of

interferometrically-coupled Fabry-Perot spacer filed cavities with a passband that may shift as a function of an applied temperature via electrodes. The Office Action further states that while Seeser teaches a temperature controlled bandpass region, two such regions are not explicitly taught. The Office Action concludes that it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate two of such regions to allow control of more than one wavelength.

To be unpatentable under 35 U.S.C. §103(a), the differences between the subject matter sought to be patented and the prior art must be such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or combine the reference teachings. To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. Also, according to the M.P.E.P. §2143.03, all claim limitations must be taught or suggested. This M.P.E.P. section states that all words in a claim must be considered in judging the patentability of the claim against the prior art.

Independent claim 23 recites a switchable optical filter comprising first and second tunable optical bandpass filter portions that are characterized by a first and second passband, respectively. Independent claim 23 has been amended to recite a spacer separating and isolating the first and second tunable optical bandpass filter portions from each other so that either one of the first and second optical bandpass filter portions can be tuned independently of the other one of them. The Applicants submit that the claimed spacer is not taught or suggested by Seeser.

The variable multi-cavity optical device described by Seeser is fundamentally different from the switchable optical filter claimed in amended independent claim 23. The optical device described by Seeser comprises a series of optically coupled cavities where each cavity comprises two reflectors with an intervening spacer that forms a single wavelength selective optical structure. See, for example, Seeser paragraph 15. In contrast, independent claim 23 recites two separate tunable optical bandpass filter portions that have separate passbands, which are independently controllable.

Another fundamental difference is that Seeser describes the use of an active spacer in the multi-cavity optical device that has an adjustable optical length. The active spacer is designed to receive a control signal that triggers a change in the physical length and/or the refractive index of the active spacer material, which consequently changes the optical length of the material. See, for example, Seeser paragraphs 15 and 16.

In contrast, the spacer claimed in independent claim 23 separates and isolates the first and second tunable optical bandpass filter portions from each other so that either one of the first and second optical bandpass filter portions can be tuned independently of the other one of them. The switchable optical filter claimed in independent claim 23 includes a static non-thermo-optic spacer that is much thicker than the thermo-optic filter portions, which are includes in some embodiments of the first and second filter portions. See, for example, paragraphs 45 of the present specification.

The purpose of the spacer claimed in independent claim 23 is to separate and isolate the first and second tunable optical bandpass filter portions from each other so that the first and second optical bandpass filter portions can be tuned independently. For example, in

embodiments where the spacer comprises a thermal isolation layer, the spacer thermally isolates the first tunable optical bandpass filter portion from the second tunable optical bandpass filter portion so that the two optical filters can be thermally tuned independently of each other. In contrast, the active spacer described in Seeser is designed to de-tune the optical structure. See, for example, Seeser paragraph 15.

Therefore, the Applicants submit that independent claim 23 is allowable over Seeser. The Applicants also submit that dependent claims 24 and 26-27 are allowable as depending upon an allowable base claim.

New Claims

New claims 31-40 have been added. Claims 31-35 are dependent upon independent claim 23 which the Applicants submit as described herein is allowable in over Seeser. Therefore, the Applicants submit that claims 31-35 are allowable as depending from an allowable base claim. Independent claim 36 recites a method of optical switching that includes steps of operating the switchable optical filter recited in independent claim 23 in one embodiment of the invention. The application submits that claims 36-40 are allowable over the prior art of record.

CONCLUSION

Claims 23-24, 26-27 and 31-40 are pending in the present application. Claims 23 and 26 have been amended. New claims 31-40 have been added. The Applicant respectfully requests reconsideration of the pending claims in light of the amendments and remarks presented in this Amendment and Response.

Authorization to charge any proper fees to Attorney's charge card is given in the EFS Web filing papers. The Commissioner is hereby also authorized to charge any proper fees to Attorney's Deposit Account No. 501211 in the event that there is a problem processing the Attorneys charge card.

If, in the Examiner's opinion, a telephonic interview would expedite prosecution of the present application, the undersigned attorney would welcome the opportunity to discuss any outstanding issues, and to work with the Examiner toward placing the application in condition for allowance.

Respectfully submitted,

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